# **United States Department of Energy**

**Nuclear Criticality Safety Program** 

## Five-Year Execution Plan for the Mission and Vision

FY2012 through FY2016





Department of Energy Nuclear Criticality Safety Program Five-Year Execution Plan for Fiscal Years 2012 through 2016, dated September 2011.

Approved:

Dr. Jerry N. McKamy

Manager

Nuclear Criticality Safety Program

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#### ACRONYMS AND DEFINITIONS

3D 3-dimensional AM Analytical Methods

AMPX Nuclear Cross-Section Processing Computer Code Developed by

**ORNL** 

ANL Argonne National Laboratory
ANS American Nuclear Society
ARH Atlantic Richfield Hanford
AWE Atomic Weapons Establishment
BNL Brookhaven National Laboratory

BUC Burn-up Credit

CAAS Criticality Accident Alarm System

CE Continuous energies

CEA Commissariat à l'Énergie Atomique

COG<sup>1</sup> Lawrence Livermore National Laboratory Monte Carlo Computer Code CritView A plotting and interpolation software program designed to display

criticality data from the ARH-600 Criticality Handbook

CSCT Criticality Safety Coordinating Team

CSE Criticality Safety Evaluation

CSEWG Cross Section Evaluation Working Group

CSSG Criticality Safety Support Group
DAF Device Assembly Facility
DOE Department of Energy
ENDF Evaluated Nuclear Data File

FY Fiscal Year

GANDER Code system to derive covariances from experimental data

GELINA Gel Linear Accelerator

GForge Web-based collaborative development environment

IAEA International Atomic Energy Agency

ICSBEP International Criticality Safety Benchmark Evaluation Project

IE Integral Experiments

IER Integral Experiment Request INL Idaho National Laboratory

IP&D Information Preservation and Dissemination

IRMM Institute for Reference Materials and Measurements IRSN Institut De Radioprotection et De Sûreté Nucléaire

k<sub>eff</sub> The mean number of fission neutrons produced by a neutron during its

life within the system

KENO<sup>2</sup> Monte Carlo Criticality Computer Code

LA Los Alamos (report)

LANL Los Alamos National Laboratory
LINAC Gaerttner Linear Accelerator at RPI

LLNL Lawrence Livermore National Laboratory

MCNP Monte Carlo N Particle (N currently equals 3) Computer Code

MG Multi-group energies

MIDAS U.S. – France collaboration on the Valduc Criticality Safety Facility

Refurbishment/Utilization program

MIRTE Matériaux Interaction Réflexion Toutes Epaisseurs

NA-16 Assistant Deputy Administrator for Facility and Infrastructure

NA-162 Office of Facilities Operations

NCERC National Criticality Experiments Research Center

NCS Nuclear Criticality Safety

NCSET Nuclear Criticality Safety Engineer Training

NCSP Nuclear Criticality Safety Program

ND Nuclear Data

NDAG Nuclear Data Advisory Group

NJOY A nuclear data processing code system

NNDC National Nuclear Data Center

NNSA National Nuclear Security Administration

NNSS Nevada Nuclear Security Site

OECD/NEA Organization for Economic Cooperation and Development/Nuclear

Energy Agency

ORNL Oak Ridge National Laboratory

POC Point of Contact

PREPRO A nuclear data processing code system

QPR Quarterly Program Review
RPI Renssalaer Polytechnic Institute

RSICC Radiation Safety Information Computational Center

SAMMY<sup>3</sup> A nuclear model computer code

SCALE<sup>4</sup> A modular modeling and simulation system for nuclear safety analysis

and design

SILÈNE Commissariat à l'Énergie Atomique Uranium Solution Critical

Assembly

SNL Sandia National Laboratories SQA Software Quality Assurance S/U Sensitivity/Uncertainty

TACS Training Assembly for Criticality Safety

TRG Technical Review Group

TSUNAMI Tool for Sensitivity and Uncertainty Analysis Methodology

Implementation

TSURFER<sup>5</sup> Tool for Sensitive and Uncertainty Analysis of Response Functionals

Using Experimental Results

V&V Verification and Validation

VIM Argonne National Laboratory Monte Carlo neutron/proton transport

code

WPEC Working Party on International Nuclear Data Evaluation Corporation

WPNCS Working Party on Nuclear Criticality Safety

ZPPR Zero-Power Plutonium Reactor

ZPR Zero-Power Reactor

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<sup>1</sup>COG was originally developed to solve deep penetration problems in support of underground nuclear testing. Variance reduction techniques are very important to these problems and hence the name COG was chosen as in "to cog the dice" or cheat by weighting.

<sup>2</sup>KENO is a family of Monte Carlo criticality codes whose name came from an observation of the KENO game in which small spheres, under air levitation, arbitrarily move about in a fixed geometry.

<sup>3</sup>SAMMY is a nuclear model code, which applies R-Matrix theory to measured data and produces resolved and un-resolved resonance parameters in Reich-Moore and other formalisms.

<sup>4</sup>SCALE is a system of well-established codes and data for performing nuclear safety (criticality, shielding, reactor physics and fuel irradiation) analyses.

<sup>5</sup>TSURFER is a module of the SCALE code system that performs a generalized linear least squares adjustment of cross-section data to produce consistency between calculated and experimental results. When coupled with TSUNAMI sensitivity data for a criticality safety application, the adjusted cross-section data can be used to predict a computational bias and its uncertainty.

## United States Department of Energy Nuclear Criticality Safety Program Five-Year Execution Plan

## 1.0 Nuclear Criticality Safety Program Mission and Vision

The Nuclear Criticality Safety Program (NCSP) Mission and Vision, as stated in *The Mission* and Vision of the United States Department of Energy Nuclear Criticality Safety Program for the Fiscal Years 2009-2018 (http://ncsp.llnl.gov/NCSP-MV-COMPRESSED.pdf), are:

The NCSP mission is to provide **sustainable expert** leadership, direction, and the technical infrastructure necessary to develop, maintain, and disseminate essential technical tools, training, and data required to support **safe**, **efficient** fissionable material **operations** within the United States (U.S.) Department of Energy (DOE).

The NCSP will be a **continually improving, adaptable,** and **transparent** program that **communicates** and **collaborates** globally to incorporate technology, practices, and programs to be **responsive** to the essential technical needs of those responsible for developing, implementing, and maintaining nuclear criticality safety.

NCSP is funded by the National Nuclear Security Administration (NNSA). Dr. Jerry McKamy (NA-162) is the NCSP Manager. He is supported by the Criticality Safety Support Group (CSSG) and the Nuclear Data Advisory Group (NDAG) regarding technical matters and by the Criticality Safety Coordinating Team (CSCT), consisting of Federal Criticality Safety Practitioners at the sites regarding DOE field criticality safety issues. Charters for the CSCT, CSSG, and the NDAG can be found on the NCSP internet website at: (http://ncsp.llnl.gov/).

#### 2.0 Technical Program Elements

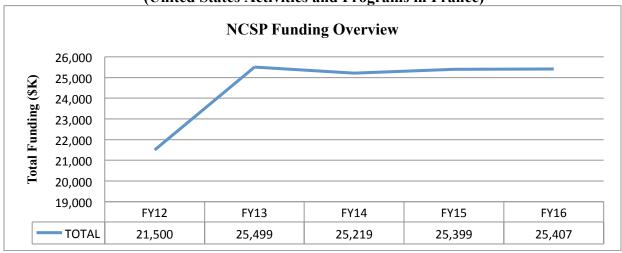
NCSP includes the following five technical program elements:

- Analytical Methods
- Information Preservation and Dissemination
- Integral Experiments
- Nuclear Data
- Training and Education

A description of how each of these elements contributes to the enhancement of criticality safety is contained in the NCSP Mission and Vision document. This Five-Year Execution Plan contains the road map for each of the five technical program elements, including a budget, tasks, and milestones for completing the work and achieving the NCSP Vision. All tasks are approved based on their contribution to the achievement of the five- and ten-year goals in the Mission and Vision document. Funding tables are provided for each program element section. The status of all milestones will be reported to the NCSP Manager in quarterly reports that are due no later than the last day of the month following the end of the quarter.

Funding for NCSP activities conducted in the United States, including programs in France are provided in Table 2-1, 2-2, and 2-3 (rounded to the nearest \$K).

Table 2.1 NCSP Funding Overview (United States Activities and Programs in France)



**Table 2.2 NCSP Funding Overview – By Element** (United States Activities and Programs in France)

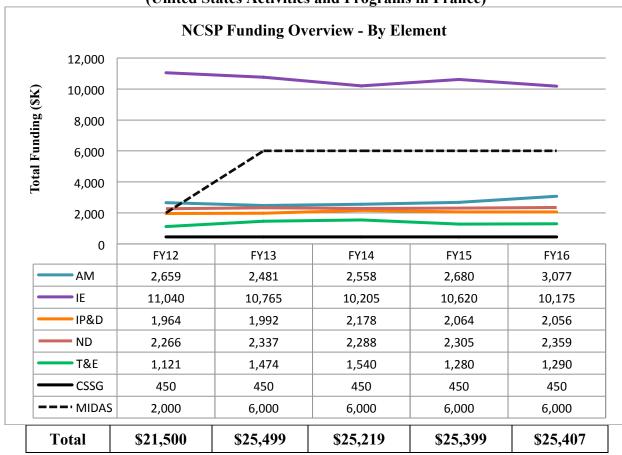


Table 2.3 NCSP Funding Overview – By Laboratory (United States Activities and Programs in France)

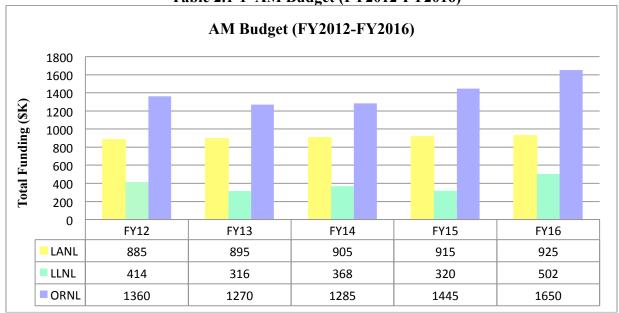
		NCSP	Funding Over	view – By Lab	oratory	
	9000					
	8000					
	7000					
Total Funding (\$K)	6000					
	5000					
tal Fun	4000	/	<u>/</u>			
To L	3000					
	2000					
	1000					
	0 -	FY12	FY13	FY14	FY15	FY16
		FY12 356	FY13 402	FY14 413	FY15 379	FY16 335
	0 -			+		
<u> </u>	O -	356	402	413	379	335
	O — ANL — BNL	356 150	402 160	413 170	379 170	335 180
	O — ANL — BNL — HAN	356 150 161	402 160 92	413 170 113	379 170 84	335 180 106
	O — ANL — BNL — HAN — INL	356 150 161 75	402 160 92 0	413 170 113 0	379 170 84 0	335 180 106 0
	O — ANL — BNL — HAN — INL — LANL	356 150 161 75 7445	402 160 92 0 7690	413 170 113 0 7480	379 170 84 0 8505	335 180 106 0 8370
	O — ANL BNL HAN INL LANL LLNL	356 150 161 75 7445 3823	402 160 92 0 7690 3495	413 170 113 0 7480 3448	379 170 84 0 8505 2805	335 180 106 0 8370 2602
	O — ANL — BNL — HAN — INL — LANL — LLNL — NNSS	356 150 161 75 7445 3823 3000	402 160 92 0 7690 3495 2900	413 170 113 0 7480 3448 2800	379 170 84 0 8505 2805 2700	335 180 106 0 8370 2602 2700
	O — ANL — BNL — HAN — INL — LANL — LLNL — NNSS — ORNL	356 150 161 75 7445 3823 3000 2836	402 160 92 0 7690 3495 2900 2842	413 170 113 0 7480 3448 2800 2973	379 170 84 0 8505 2805 2700 2894	335 180 106 0 8370 2602 2700 3184
	O — ANL BNL HAN INL LANL LINL NNSS ORNL RPI	356 150 161 75 7445 3823 3000 2836 314	402 160 92 0 7690 3495 2900 2842 318	413 170 113 0 7480 3448 2800 2973 322	379 170 84 0 8505 2805 2700 2894 362	335 180 106 0 8370 2602 2700 3184 330

Finally, the goal of the NCSP is to provide "transparent responsiveness" for the DOE and Stakeholders. Therefore, this Plan and all accomplishments achieved under the auspices of the NCSP are posted in a timely manner on the NCSP website at: <a href="http://ncsp.llnl.gov/">http://ncsp.llnl.gov/</a>.

## 2.1 Analytical Methods (AM)

## 2.1.1 Program Element Description

The Analytical Methods (AM) program element provides development and maintenance of state-of-the-art analytical capability for the processing of nuclear data from the Evaluated Nuclear Data File (ENDF) and the radiation transport analysis needed to support Nuclear Criticality Safety (NCS) evaluations for subcriticality and shielding. An essential aspect of this capability is the human expertise required to develop the analytical software, provide software configuration control, and train and assist the user community.



**Table 2.1-1 AM Budget (FY2012-FY2016)** 

## 2.1.2 Approved Tasks

#### 2.1.2.1 Los Alamos National Laboratory (LANL)

#### **LANL AM1 (\$785K)**

Maintenance of the basic capabilities for performing NCS calculations with MCNP, including general code maintenance, user support, improved nuclear data libraries, Verification and Validation (V&V), documentation, user training, and implementation of limited new capabilities. For all tasks, LANL reports will be issued and posted on the MCNP website.

## LANL AM2 (\$100K)

Support development and maintenance of the NJOY nuclear data processing code system. Implement capabilities as needed to process new general purpose nuclear data files in the continuously evolving ENDF-6 format, including covariance data and new reaction identifiers that support specialized data files such as the International Reactor Dosimetry File, IRDF-2010. Base versions of the NJOY code system will continue to be distributed to the domestic user

community through Radiation Safety Information Computational Center (RSICC) and to the international user community through the Nuclear Energy Agency (NEA) Data Bank, with code updates distributed to all users through a LANL maintained website.

LANL AM Budget Trend (FY2012-FY2016) 930 Total Funding (\$K) 920 910 900 890 880 870 860 FY12 FY13 FY14 FY15 FY16 LANL 885 895 905 915 925

Table 2.1-2 LANL AM Budget Trend (FY2012-FY2016)

**Table 2.1-3 LANL AM Planned Spending (FY2012)** (FY2012) LANL AM Planned Spending 1000 900 Fotal Planned Spending (\$K) 800 700 600 500 400 300 200 100 0 Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep All Tasks 73 147 221 295 368 443 516 590 664 736 811 885

**LANL AM Milestones:** 

#### Quarter 2

• Issue an MCNP V&V report (T1: Q2).

## **Quarter 3**

• Provide one on-site class at a DOE site on the theory and practice of Monte Carlo criticality calculations with MCNP (T1: Q3).

#### Quarter 4

- Implement a test for population size and other new diagnostics into MCNP (T1: Q4).
- Improve the MCNP capabilities for performing uncertainty quantification (T1: Q4).

- Prepare a tutorial report on using MCNP for analyzing criticality alarm systems (T1: Q4).
- Release quality-assured MCNP neutron cross-section library for ENDF/B-VII.1 update to RSICC (T1: Q4).
- Provide user guidance and support for migrating from MCNP5 to MCNP6 (T1: Q4).
- Participate in Expert Groups related to analytical methods that are important to criticality safety, including the OECD/NEA expert groups on uncertainty analyses for criticality safety assessment (T1: Q4).
- Implement new ENDF-6 formats into NJOY (T2: Q4).

## 2.1.2.2 Lawrence Livermore National Laboratory (LLNL)

## LLNL AM1 (\$214K)

Provide maintenance, user support, and modest upgrades to existing LLNL AM including nuclear data processing, geometry modeling, and Monte-Carlo methods. This task also supports on-going LLNL assistance to the International Atomic Energy Agency (IAEA) in developing and maintaining the PREPRO nuclear data processing code system as needed to process and distribute new general-purpose nuclear data files in evolving ENDF-6 format. The task also supports participation in NCSP activities including the Cross Section Evaluation Working Group (CSEWG) and NDAG.

## LLNL AM2 (\$200K)

Support new work building upon existing LLNL state-of-the-art 3-D analytical multi-physics methods to develop and validate these methods for simulation of criticality excursions.

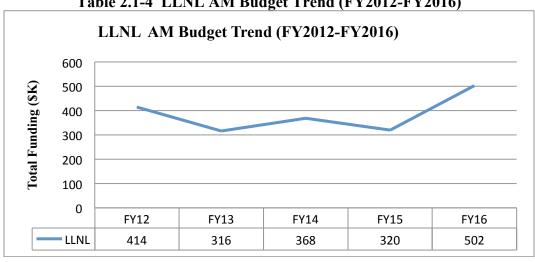
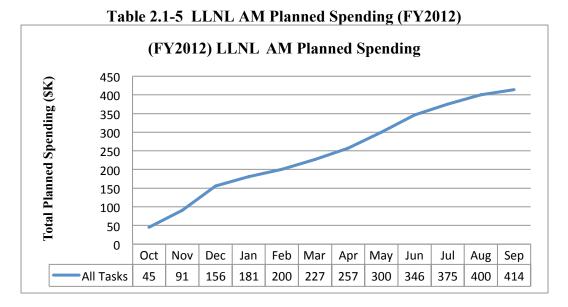


Table 2.1-4 LLNL AM Budget Trend (FY2012-FY2016)



## **LLNL AM Milestones:**

#### Quarter 4

- Release PREPRO code updates and processed nuclear data for ENDF/B-VII.1 and subsequent releases to the IAEA (T1: Q4).
- Release COG supplemental library (or COG update, if required) with an ENDF/B-VII.1 nuclear data library (T1: Q4).
- Publish a preliminary report summarizing the available fast burst reactor excursion data such as fission yield, power history, surface motion, and temperature data suitable for validation (T2: Q4).

## 2.1.2.3 Oak Ridge National Laboratory (ORNL)

## ORNL AM1 (\$380K)

The RSICC ongoing approved task is to collect, update, package, and distribute software and associated nuclear data libraries to the criticality safety community (i.e., SCALE, MCNP, VIM, and COG and nuclear data processing [i.e., NJOY, AMPX, and SAMMY]). Also, test and disseminate processed nuclear data associated with the software.

#### ORNL AM2 (\$680K)

Provide SCALE/KENO/TSUNAMI maintenance and user support for performing NCS calculations with the SCALE package. Work tasks include sustaining and continually improving SCALE NCS features through user-driven enhancements, Software Quality Assurance (SQA) and V&V; assuring adaptability to various computing platforms and compilers; providing improved user interfaces and user documentation consistent with modern engineering software; and supporting responsive communication to SCALE criticality safety users through SCALE newsletters, email notices, and updates on the SCALE website.

## ORNL AM3 (\$100K)

Ongoing approved task to develop and maintain the AMPX nuclear data processing code system to provide cross-section and covariance data libraries for NCS radiation transport software such as SCALE. The development and maintenance work effort will ensure the AMPX software is up-to-date and in conformance with ENDF/B formats and procedures. Moreover, the development and enhancements to the AMPX software will enable improved nuclear data processing capabilities needed to support radiation transport methods development and analyses.

## ORNL AM4 (\$100K)

A computational analysis capability will be developed to perform 3-dimensional (3D) fixed-source S/U analyses to enable the analysis and design of shielding experiments such as those needed for CAAS analyses. The sensitivity data from this 3D fixed source S/U tool will be compatible with all the TSUNAMI tools, so similarity assessment of experiments, bias determination, and visualization will all be possible.

## ORNL AM5 (\$100K)

New work task is to produce continuous-energy (CE) and multi-group (MG) cross-section libraries and covariance data libraries for the SCALE criticality safety analyses software based on the release of ENDF/B-VII.1 and subsequent releases of the latest ENDF/B evaluations from the National Nuclear Data Center (NNDC).

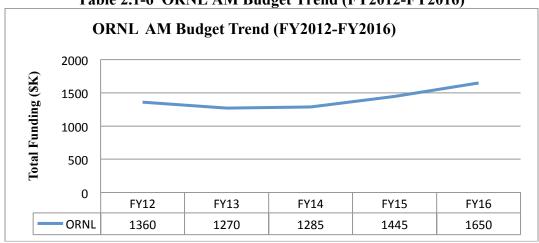
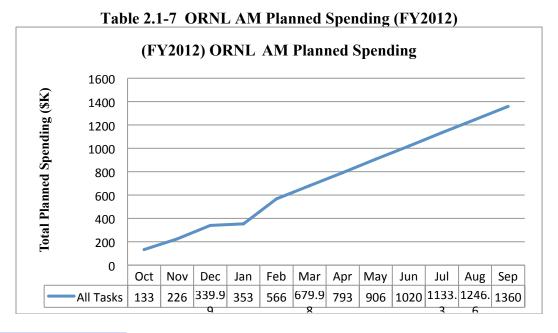


Table 2.1-6 ORNL AM Budget Trend (FY2012-FY2016)



#### **ORNL AM Milestones:**

#### **Occurs all 4 Quarters**

• Continue distribution of available and newly packaged software to the NCS community requesters (at no direct cost to them) and provide distribution totals quarterly (T1: All Qtrs).

#### Quarter 1

• Issue an annual SCALE maintenance report to the NCSP Manager (T2: Q1).

## Quarter 2

• Publish semiannual newsletters to users to communicate software updates, user notices, generic technical advice, and training course announcements (T2: Q2, Q4).

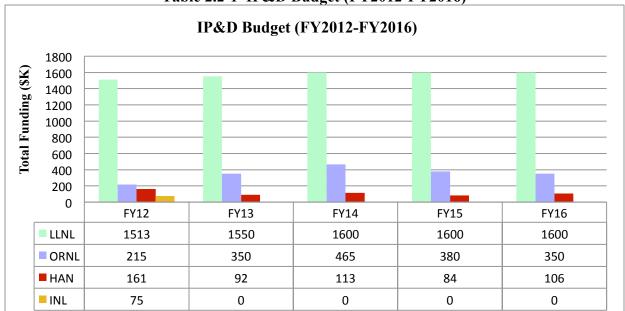
#### **Quarter 4**

- Publish semiannual newsletters to users to communicate software updates, user notices, generic technical advice, and training course announcements (T2: Q2, Q4).
- Participate in Expert Groups related to analytical methods that are important to criticality safety, including the OECD/NEA expert groups on uncertainty analyses for criticality safety assessment (T2: Q4).
- Document AMPX technical support for SCALE CE, multigroup, and covariance libraries, and report status annually to the NCSP Manager (T3: Q4).
- Complete ORNL technical report that provides user guidance for accurate CAAS analyses based on state-of-the-art computational tools (T4: Q4).
- Complete letter report describing outstanding user needs for CAAS analyses, based on SILÈNE measurements, and work required to address these needs (T4: Q4).
- Complete production-level sensitivity and uncertainty analysis tool for CAAS for release with SCALE 6.2 (T4: Q4).
- Produce prototypic ENDF/B-VII.1 CE, MG, and covariance libraries to be available for testing with SCALE at ORNL (T5: Q4).
- Complete prototypic sensitivity and uncertainty analysis tool for CAAS analysis (T5: Q4).

## 2.2 Information Preservation and Dissemination (IP&D)

## 2.2.1 Program Element Description

The Information Preservation and Dissemination (IP&D) program element preserves primary documentation supporting criticality safety and makes this information available for the benefit of the technical community. The NCSP website (<a href="http://ncsp.llnl.gov">http://ncsp.llnl.gov</a>) is the central focal point for access to criticality safety information collected under the NCSP, and the gateway to a comprehensive set of hyperlinks to other sites containing criticality safety information resources.



**Table 2.2-1 IP&D Budget (FY2012-FY2016)** 

#### 2.2.2 Approved Tasks

## 2.2.2.1 **Hanford**

## Hanford IP&D1 (\$41K)

Provide V&V for MCNP and selected SCALE code calculations to be added to the database for CritView and provide documentation of these data and incorporation into the CritView Program. Maintain and upgrade CritView as funding permits and provide limited response to user queries and any error identification.

## Hanford IP&D2 (\$120K)

Develop a method for obtaining integral cross sections for actinides from reactor operations and special test data. This task will also develop a data record matrix for isotopes and reactors.

Table 2.2-2 Hanford IP&D Budget Trend (FY2012-FY2016) Hanford IP&D Budget Trend (FY2012-FY2016) 200 **Fotal Funding (SK)** 150 100 50 0 FY12 FY13 **FY14** FY15 FY16 161 92 HAN 113 84 106

**Hanford IP&D Milestones:** 

0

**Tasks** 

Oct

7

Nov

17

Dec

22

Jan

32

#### **Ouarter 2**

• Update existing compilation of data (reactor and special test), issue data compilation report, and provide report on NCSP website (T2: Q2).

Feb

42

Mar

52

Apr

62

May

76

Jun

92

Jul

114

Aug

136

Sep

161

• Issue letter report documenting computer model for extraction and sensitivity calculations to LLNL for posting on the website (T2: Q2).

#### **Ouarter 4**

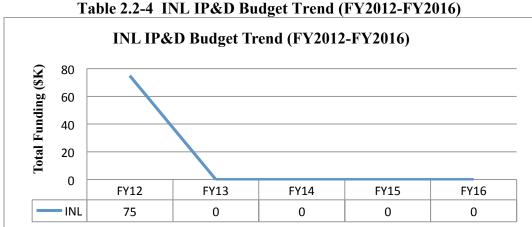
- Provide updated and document changes to data files to LLNL for posting on the NCSP website (MCNP, SCALE, Atlantic Richfield Hanford (ARH)-600, Los Alamos (LA)-10860) (T1: Q4).
- Provide updated and documented CritView code to new operating system to LLNL for posting on the NCSP website (T1: Q4).
- Issue letter report for U-Pu Tree with integral cross section and possible benchmark listing and provide report on NCSP website (T2: Q4).

• Issue letter report for demonstration of alternate information extraction and provide report or NCSP website (T2: Q4).								

## 2.2.2.2 Idaho National Laboratory (INL)

## INL IP&D1 (\$75K)

Aid in transition from INL to LLNL of the International Criticality Safety Benchmark Evaluation Project (ICSBEP) Independent and Technical Review Group (TRG) reviews for all newly completed U.S. funded experiments. The experiments will be finalized and published on the NCSP website within two quarters of receipt of an Experiment Design Team reviewed and approved draft report (CED-4a). INL IP&D Task 1 will also provide assistance in transitioning leadership, coordination, and publication support for the Organization for Economic Cooperation and Development (OECD)/NEA ICSBEP to LLNL.



(FY2012) INL IP&D Planned Spending 80 Fotal Planned Spending (\$K) 70 60 50 40 30 20 10 0 Oct Mar Jul Nov Dec Jan Feb Apr May Jun Aug Sep All Tasks 10 15 20 25 30 37 44 50 56 62 68 75

Table 2.2-5 INL IP&D Planned Spending (FY2012)

#### **INL IP&D Milestones:**

## Occurs all 4 Quarters

• Transition ICSBEP to LLNL (T1: All Otrs).

## 2.2.2.3 Lawrence Livermore National Laboratory (LLNL)

## LLNL IP&D1 (\$800K)

Ongoing approved activity that provides Independent and TRG reviews for all newly completed U.S. funded experiments. Priority historical experiments will be evaluated and reviewed (internal, independent, and TRG) as resources allow. All U.S. funded experiments will be finalized and published on the NCSP website within two quarters of receipt of an Experiment Design Team reviewed and approved draft report (CED-4a). LLNL IP&D Task 1 will also provide leadership, coordination, and publication support for the OECD/NEA ICSBEP.

## LLNL IP&D2 (\$713K)

Operates and maintain the NCSP website. The NCSP website is the central focal point for access to criticality safety information collected under the NCSP, and is the gateway to a comprehensive set of hyperlinks to other sites containing criticality safety information resources. This task also provides operations and maintenance for information technology supporting the NCERC (e.g., "Red" network).

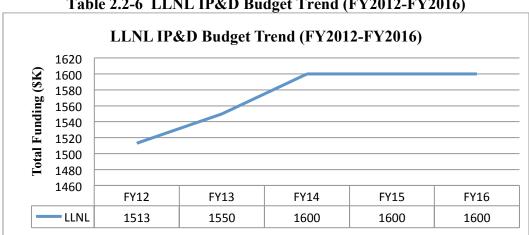
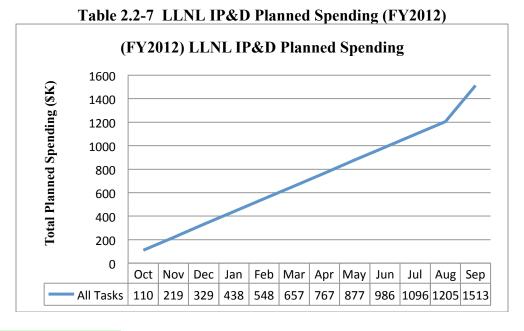


Table 2.2-6 LLNL IP&D Budget Trend (FY2012-FY2016)



**LLNL IP&D Milestones:** 

#### **Occurs all 4 Quarters**

- Maintain, operate, and develop the NCSP website and "Red" network (T2: All Qtrs).
- Maintain and develop the IE and ND request forms (T2: All Qtrs).
- Develop and deploy multimedia web-based training and videos as directed by the IP&D Manager (T2: All Qtrs).
- Digitize and archive unclassified and classified hardcopy bibliography reports starting with the LLNL hardcopy report collections (T2: All Qtrs).
- Maintain and develop the searchable LLNL, Hanford, and CSE databases (T2: All Qtrs).

#### **Ouarter 1**

• Deploy ICSBEP web content on the NCSP website (T1: Q1).

#### **Ouarter 2**

- Maintain and develop ICSBEP web content (T1: Q2, Q3, Q4).
- Hold Annual ICSBEP TRG meeting (T1: Q3).

#### **Ouarter 3**

- Maintain and develop ICSBEP web content (T1: Q2, Q3, Q4).
- Deploy the contents of the LA-10860-MS DVD contents on the NCSP website (T2: Q3).
- Procure classified website hardware and software (T2: O3).

#### **Ouarter 4**

- Maintain and develop ICSBEP web content (T1: Q2, Q3, Q4).
- Submit security plan to Livermore Site Office for approval to operate a classified NCSP website (T2: Q4).
- Complete independent and TRG reviews of the Matériaux Interaction Réflexion Toutes Epaisseurs MIRTE-1 experiments and finalize for publication (proprietary until December 31, 2017) carried over from Fiscal Year (FY) 2011 (T1: Q4).

• Complete the annual publication of *International Handbook of Evaluated Criticality Safety* Benchmark Experiments and submit to the OECD/NEA for replication and distribution (T1: Q4).

## 2.2.2.4 Oak Ridge National Laboratory (ORNL)

#### ORNL IP&D1 (\$100K)

Provide TSUNAMI-generated sensitivity data files and verified SCALE input files for new benchmark evaluations that will be published in the ICSBEP Handbook in FY2012 and the out years. Moreover, this task is "forward-looking" and focused on preparing sensitivity data files and verified SCALE input files for new benchmark experiments that will be published in the ICSBEP Handbook in the future. In this task, all work will be conducted within the quality assurance framework established by the SCALE Procedure for Verification and Configuration Management of Models and Derived Data. Additionally, ongoing approved task to provide the design, evaluation, and documentation of benchmark quality measurements for Criticality Accident Alarm System (CAAS) experimental configurations to be performed at Commissariat à l'Énergie Atomique (CEA) experiment facilities in Valduc, France and the National Criticality Experiments Research Center (NCERC) in the United States.

## ORNL IP&D2 (\$60K)

Collect, catalog, and preserve criticality document collections amassed by Dixon Callihan, Joe Thomas, Howard Dyer, and Jim Mincey.

#### ORNL IP&D3 (\$55K)

Support NCSP efforts to provide experimental uncertainty correlations for select ICSBEP benchmarks. During FY2012, work will be performed to establish preliminary algorithms to quantify correlations in benchmark  $k_{eff}$  uncertainties for various types of experiments such as solutions, lattices, and metals.

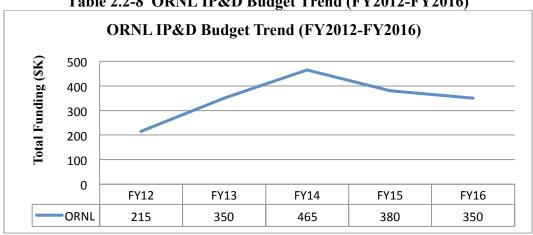
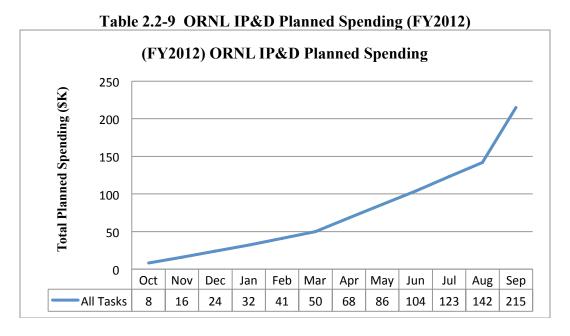


Table 2.2-8 ORNL IP&D Budget Trend (FY2012-FY2016)



#### **ORNL IP&D Milestones:**

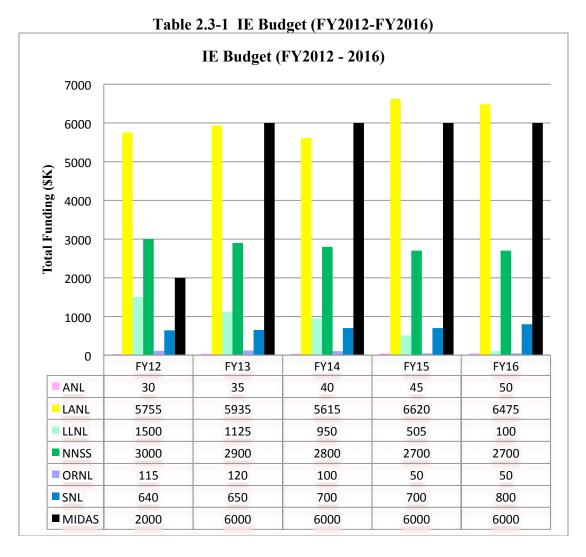
#### Quarter 4

- Provide TSUNAMI sensitivity data files and inputs for new ICSBEP evaluations (T1: Q4).
- Inventory approximately one-third of the ORNL NCS document collections of Dixon Callihan, Joe Thomas, and Jim Mincey, create a bibliographic record, and provide the record for posting on the DOE NCSP website (T2: Q4).
- Complete draft evaluation of second and third SILÈNE benchmark configurations (T1: Q4).
- For select ICSBEP benchmarks, provide TSUNAMI sensitivity data files and associated SCALE input decks to the ICSBEP for distribution (T1: Q4).
- Develop preliminary algorithms for the determination of experimental uncertainty correlations (T3: Q4).
- Issue letter report to NCSP Manager documenting work progress on the development of algorithms for the determination of experimental uncertainty correlations (T3: Q4)

## 2.3 Integral Experiments (IE)

#### 2.3.1 Program Element Description

The Integral Experiments (IE) program element maintains a fundamental capability for the DOE NCSP to be able to perform critical, subcritical, and fundamental physics measurements, within the limits of its resources, to address specific-site needs on a prioritized basis. This program element also supports maintaining a fundamental nuclear materials handling capability which enables hands-on NCS training programs and various other programs for the DOE NCSP and other government agencies.



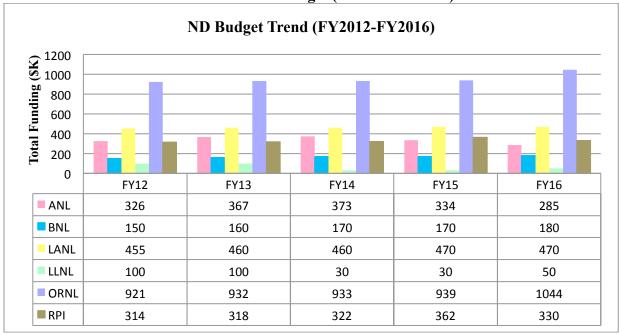
All Integral Experiment tasks and milestones are published as standalone documents. Contact the NSCP Program Manager, Dr. Jerry McKamy, if you have a 'Need-to-Know.'

## 2.4 Nuclear Data (ND)

## 2.4.1 Program Element Description

The Nuclear Data (ND) program element includes the measurement, evaluation, testing, and publication of neutron cross-section data for nuclides of high importance to NCS analyses. The NCSP continues to improve coordination of ND activities by fostering a strong collaborative effort among all of the national and international resources in this highly technical area. The objective is to solve the highest priority ND problems relevant to criticality safety in a timely manner. This program element is essential for the NCSP because it provides the nuclear cross-section data required by the AM program element. Refer to Appendix B for the FY2012 through FY2016 schedule, milestones, and deliverables associated with specific nuclear data

measurement, evaluation, and publication. Milestones not contained in Appendix B are delineated below.



**Table 2.4-1 ND Budget (FY2012-FY2016)** 

## 2.4.2 Approved Tasks

## 2.4.2.1 Argonne National Laboratory (ANL)

## ANL ND1 Subtask 1(\$185K)

Perform on-going data testing in support of the data validation effort for ENDF/B-VII and new evaluated nuclear data that are of interest to the criticality safety community. Emphasis is on testing and reporting performance of priority evaluations identified by the NDAG. Support the NCSP website initiatives for addressing differential nuclear data needs. Participate and provide leadership roles in nuclear data international expert groups and working groups.

## ANL ND1 Subtask 2(\$41K)

Support on-going development of advanced nuclear data covariance methodologies (e.g., material-to-material covariance, application of GANDER to assess nuclear data requirements, etc.), formats, and quality assurance. Emphasis is to assure development of high-quality covariance files required for NCSP S/U methods. This effort is lead by nuclear data experts Doug Muir and Donald Smith (Argonne special term appointees), including the chairman of the CSEWG Covariance Committee.

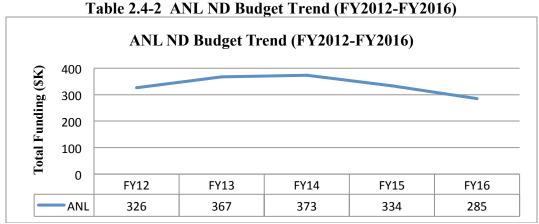
## ANL ND1 Subtask 3(\$75K)

Generate integral experiment covariance data in on-going support of S/U methods, Uncertainty Quantification and nuclear data adjustment methods. Develop evaluation methodology for these covariance data and apply to the ANL Zero Power Reactor (ZPR) and Zero Power Plutonium

Reactor (ZPPR) experiments available in the ICSBEP Handbook. Covariance data will be produced for the full set of ANL benchmarks in FY2012. On-going support will apply the methodology to produce covariance files for priority integral data for the NCSP.

## **ANL ND2 (\$25K)**

The NDAG, through making recommendations to the NCSP Manager, enhances the coordination of the NCSP ND element work program with current and future DOE needs and promotes the integration of this work program with other elements of the NCSP. The NDAG Chair receives funding (\$25K) to support his management of the NDAG.



**Table 2.4-3 ANL ND Planned Spending (FY2012)** (FY2012) ANL ND Planned Spending Total Planned Spending (\$K) 350 300 250 200 150 100 50 0 Oct Dec Feb Jun Jul Nov Jan Mar Apr May Aug Sep 28 283 All Tasks 55 83 110 138 165 193 221 248 266 326

#### **ANL ND Milestones:**

#### Occurs all 4 Quarters

• Provide NCSP NDAG Chairperson support (T4: All Qtrs).

#### Quarter 1

- Provide reports to NDAG and CSEWG documenting results of NCSP data testing and validation (T1: Q1, Q3).
- Chair meetings of the CSEWG Covariance Committee and report contributions through NDAG and CSEWG (T2: Q1, Q3).

#### **Ouarter 2**

• Report progress on evaluation methodology and preliminary results (T3: Q2).

#### Quarter 3

- Provide reports to NDAG and CSEWG documenting results of NCSP data testing and validation (T1: Q1, Q3).
- Chair meetings of the CSEWG Covariance Committee and report contributions through NDAG and CSEWG (T2: Q1, Q3).
- Participate as ENDF representative in the OECD/NEA Working Party on International Nuclear Data Evaluation Corporation (WPEC) annual meeting and various subgroup activities, including the High-Priority Request List (T1: Q3).

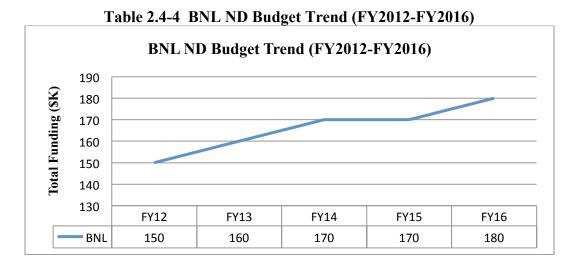
## Quarter 4

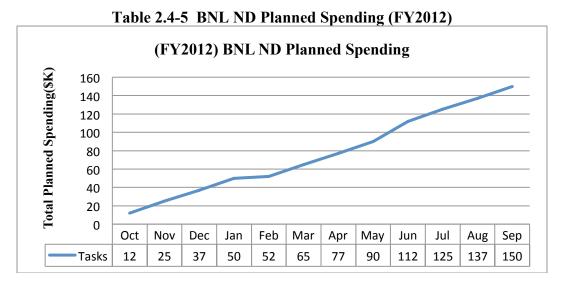
- Participate as NCSP representative to the OECD/NEA Working Party on NCS Working Party on Nuclear Criticality Safety (T1: Q4).
- Participate in Expert Groups related to nuclear data that are important to criticality safety, including the OECD/NEA expert groups on uncertainty analyses for criticality safety assessment, Assay Data for Spent Nuclear Fuel for Burn-Up Credit (BUC), expert group on BUC, and WPEC SG33 on methods and issues for the combined use of integral experiments and covariance data (T1: Q4).
- Document additional capability to produce quality covariance evaluations for ENDF (T2: Q4).
- Deliver completed covariance evaluations to ICSBEP project (T3: Q4).

## 2.4.2.2 Brookhaven National Laboratory (BNL)

## **BNL ND1 (150K)**

Provide technical support to the NCSP to ensure that NCSP cross-section evaluations are checked, processed, visualized, reviewed, archived, and made available through the NNDC GForge system as candidate evaluations for the future versions of the ENDF/B library. Maintain Atlas of Neutron Resonances as a unique resource of thermal and resonance data and their uncertainties. This is an approved ongoing task.





## **BNL ND Milestones:**

## Occurs all 4 Quarters

• Perform data verification of new NCSP evaluations and store them in the GForge server (T1: All Qtrs).

## Quarter 2

• Perform quality assurance of covariance data in new NCSP evaluations (T1: Q2).

## Quarter 4

• Perform quality assurance of covariance data in new NCSP evaluations (T1: Q4).

## 2.4.2.3 Los Alamos National Laboratory (LANL)

## **LANL ND1 (\$455K)**

Provide differential data evaluation, covariance development, and data testing work in the energy region above the resonance range for heavy elements (often in partnership with resonance-range work from ORNL), and over the entire ENDF energy range for light elements.

Table 2.4-6 LANL ND Budget Trend (FY2012-FY2016) LANL ND Budget Trend (FY2012-FY2016) 475 Total Funding (SK) 470 465 460 455 450 445 FY12 FY13 FY14 FY15 FY16 455 460 460 470 470 LANL

**Table 2.4-7 LANL ND Planned Spending (FY2012)** (FY2012) LANL ND Planned Spending 500 **Fotal Planned Spending (SK)** 450 400 350 300 250 200 150 100 50 0 Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep All Tasks 37 74 148 185 222 259 370 407 455 111 296 333

#### **LANL ND Milestones:**

#### **Ouarter 1**

• Propose format for p(nu) data to CSEWG for ENDF (T1: Q1).

## **Quarter 3**

• Participate as ENDF representative in the OECD/NEA Working Party on International Nuclear Data Evaluation Corporation (WPEC) annual meeting and various subgroup activities, including the data adjustment expert groups (T1: Q3).

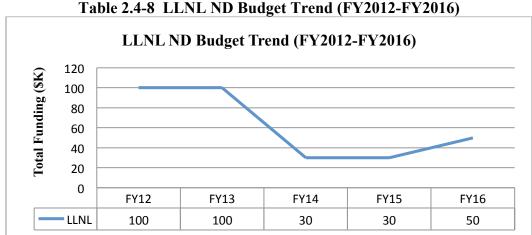
## **Quarter 4**

- Deliver updated high-energy evaluations for Ni-58 and Ni-60 to NNDC (T1: Q4).
- Using systematics, improve Prompt Fission Neutron Spectra for all minor actinides and deliver updated evaluations to NNDC (T1: Q4).

## 2.4.2.4 Lawrence Livermore National Laboratory (LLNL)

## LLNL ND1 (\$100K)

Develop a first principles analytic method to determine the equilibrium and time-dependent emission of delayed gammas based on event-by-event modeling of the fission process and subsequent fission product decay. The task includes complete generation of delayed fission gamma data for all available nuclides in FY2012 and issuance of a comprehensive final report in FY2013 documenting the technical basis of the method and data test results.



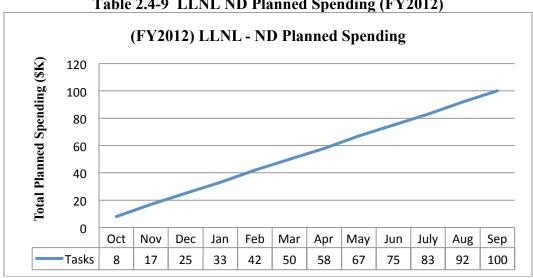


Table 2.4-9 LLNL ND Planned Spending (FY2012)

#### **LLNL ND Milestones:**

#### **Ouarter 4**

• Complete generation of delayed fission gamma data for all available nuclides (T1: Q4).

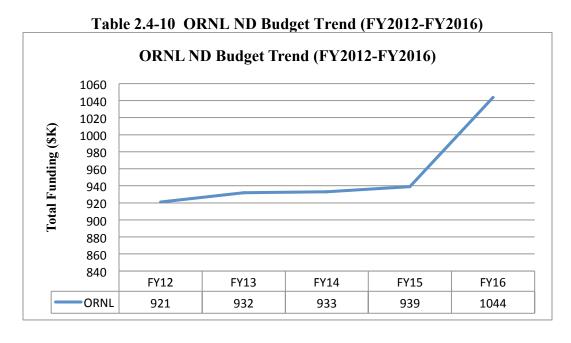
## 2.4.2.5 Oak Ridge National Laboratory (ORNL)

## ORNL ND1 (\$880K)

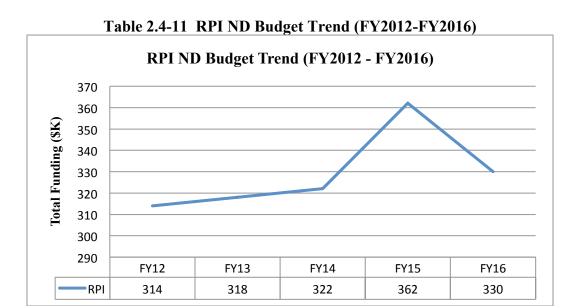
Conduct nuclear data measurement and evaluation activities in support of the NCSP. This task continues to primarily focus on the resonance-region and includes cross-section measurements and the production of new cross-section evaluations with covariance data. The ORNL nuclear data measurements and evaluations are performed in accordance with the milestone schedule in Appendix B.

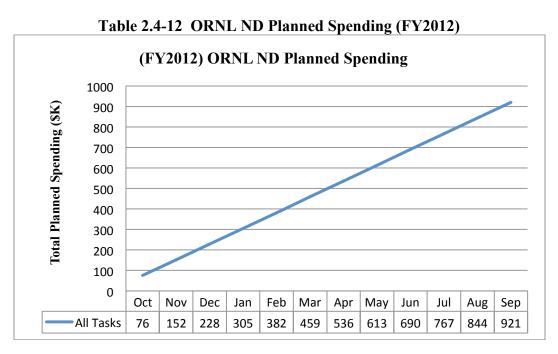
# ORNL ND2 (\$41K to ORNL; \$314K to Renssalaer Polytechnic Institute (RPI) through Naval Reactors)

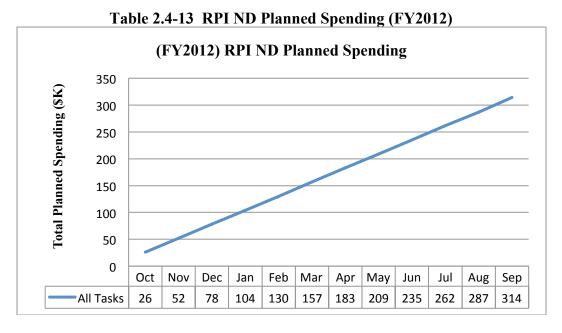
Ongoing approved task for ORNL and RPI collaboration to broaden and maintain the U.S. cross-section measurement capabilities to support NCSP experimental nuclear data needs by enabling NCSP related nuclear data measurement at the RPI Gaerttner Linear Accelerator (LINAC) laboratory.



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#### **ORNL ND Milestones:**

#### Quarter 2

• Capability development: Perform scoping measurements with prototype detectors (T2: Q2).

#### **Ouarter 3**

• Participate as ENDF representative in the OECD/NEA Working Party on International Nuclear Data Evaluation Corporation (WPEC) annual meeting and various subgroup activities, including the data adjustment expert groups (T1, T2: Q3).

#### **Ouarter 4**

- Complete cross-section measurement and evaluation deliverables per the nuclear data schedule in Appendix B (T1: Q4).
- Capability development: Build flight station and new capture detector (T2: Q4).
- Measurements: Complete measurement of <sup>238</sup>U scattered and fission neutrons (0.5-20 MeV) (T2: Q4).
- Measurements: Complete transmission measurements to supplement ORNL measurements planned at Institute for Reference Materials and Measurements (T2: Q4).

## 2.5 Training and Education (T&E)

## 2.5.1 Program Element Description

The Training and Education (T&E) program element will continue to offer hands-on training courses as needed by DOE and identify and develop training needs and resources in areas where no suitable materials exist. The primary purpose of the T&E element is to maintain the technical capabilities of criticality safety professionals and provide for the training and education of people entering the criticality safety discipline from related scientific fields.

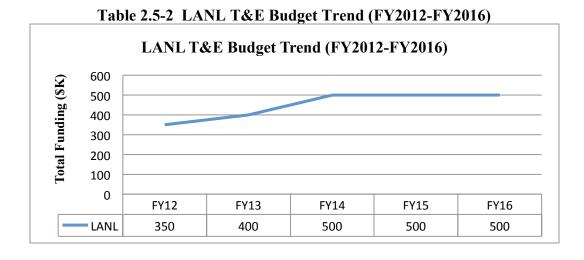
**Table 2.5-1 T&E Budget (FY2012-FY2016) T&E Budget (FY2012-FY2016)** Total Funding (SK) FY12 FY13 FY14 FY15 FY16 LANL LLNL ORNL SNL 

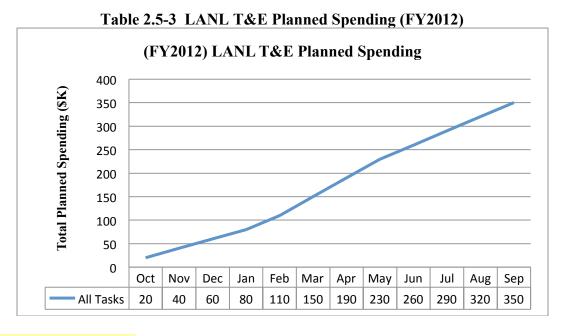
2.5.2 Approved Tasks

## 2.5.2.1 Los Alamos National Laboratory (LANL)

## LANL T&E1 (350K)

Conduct combined criticality safety classroom and hands-on training at LANL and NCERC according to an integrated schedule developed by ORNL and approved by the NCSP Manager.





#### **LANL T&E Milestones:**

#### Occurs all 4 Quarters

• Provide class room and hands-on training at LANL and at NCERC in accordance with the approved schedule and provide status reports on all training activities in the NCSP Quarterly Progress Reports (T1: All Qtrs).

#### 2.5.2.2 Lawrence Livermore National Laboratory (LLNL)

## LLNL T&E1 (\$250K)

On-going approved activity to provide unique "hands-on" training at the Device Assembly Facility (DAF) using the Training Assembly for Criticality Safety (TACS). Specifically, the task provides for LLNL support for four classes in FY2012, six classes in FY2013 and eight classes in FY2014 and beyond.

#### LLNL T&E2 (\$46K)

New work to convert existing text-based Nuclear Criticality Safety Engineer Training (NCSET) training modules into modern multimedia presentations including embedded video and computerized artwork to facilitate comprehension of the training. The approved schedule includes completion of Module 8 (Hand Calculation Methods, Part I), Module 14 (A Review of Criticality Accidents) and Module 13 (Measurement and Development of Cross Section Sets) in FY2012, FY2013, and FY2014, respectively.

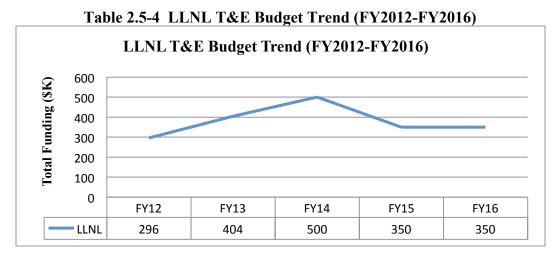


Table 2.5-5 LLNL T&E Planned Spending (FY2012) (FY2012) LLNL T&E Planned Spending 350 **Fotal Planned Spending (\$K)** 300 250 200 150 100 50 0 Dec Feb Sep Oct Nov Jan Mar Apr May Jun Jul Aug All Tasks 25 50 74 98 123 148 172 197 221 247 271 296

## **LLNL T&E Milestones:**

#### **Ouarter 4**

- Complete registration process and provide "hands-on" TACS training in support of four "hands-on" courses in accordance with the schedule approved by the NCSP Manager (T1: Q4).
- Complete multimedia conversion of NCSET Module 8, Hand Calculations Methods, Part (T2: Q4).

## 2.5.2.3 Oak Ridge National Laboratory (ORNL)

## ORNL T&E1 (\$225K)

Manage the collaborative multi-laboratory development, designing, and scheduling of the multifaceted and phased NCSP training program and oversee the execution of the program. In addition, ORNL will organize and host the annual NCSP Technical Seminar.

Table 2.5-6 ORNL T&E Budget Trend (FY2012-FY2016) ORNL T&E Budget Trend (FY2012-FY2016) 250 Total Funding (\$K) 200 150 100 50 0 FY12 FY13 FY14 FY15 FY16 ORNL 225 190 90 170 80

Table 2.5-7 ORNL T&E Planned Spending (FY2012) (FY2012) ORNL T&E Planned Spending 250 Fotal Planned Spending (SK) 200 150 100 50 0 Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug All Tasks 17 34 51 77 103 129 145 161 177 193 209 225

### **ORNL T&E Milestones:**

#### Occurs all 4 Quarters

• Provide status reports in NCSP Quarterly Progress Reports on implementation and coordination of the NCS training program (T1: All Qtrs).

### Quarter 2

• Organize and host the annual NCSP Technical Seminar (T1: Q2).

### 2.5.2.4 Sandia National Laboratories (SNL)

### **SNL T&E1 (\$250K)**

Conduct criticality safety training classes at SNL according to an integrated schedule developed by ORNL and approved by the NCSP Manager. Four classes will be provided in FY2012, six in FY2013, and eight in each of FY2014 through FY2016.

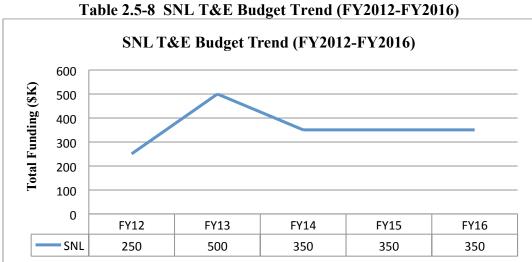


Table 2.5-9 SNL T&E Planned Spending (FY2012) (FY 2012) SNL T&E Planned Spending 300 Fotal Planned Spending (\$K) 250 200 150 100 50 0 Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep All Tasks 10 15 35 50 69 85 105 130 150 180 200 250

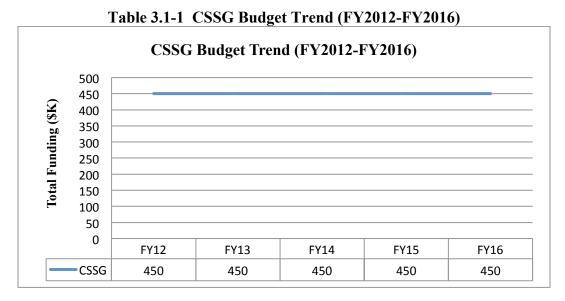
# **SNL T&E Milestones:**

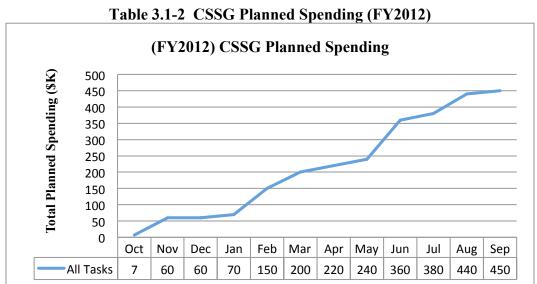
### **Quarter 4**

• Conduct four hands-on training classes in accordance with the approved schedule (T1: Q4).

### 3.0 Criticality Safety Support Group (CSSG)

The CSSG is comprised of recognized criticality safety experts from DOE offices and contractor organizations. The primary function of the CSSG is to provide operational and technical expertise to the DOE through the NCSP Manager. The CSSG also provides the NCSP Manager with technical reviews of orders, standards, rules, and guides issued by DOE related to criticality safety. In addition, the CSSG responds to requests from the NCSP Manager for information, technical reviews, and evaluations of criticality safety issues throughout the complex. The CSSG receives modest support for its contractor members (eight CSSG contractor members' \$50K/member + \$25K for the CSSG Chair + \$25K for the CSSG Deputy Chair).





# Appendix A

# Work Authorization Statements for Nuclear Criticality Safety Program Funding for Execution Year (FY2012) Provided to the NA-16 Budget Office in September 2011

**Argonne National Laboratory (ANL): \$406K** 

Tasks: Nuclear Data and the Criticality Safety Support Group

Reflects funds to continue supporting nuclear data activities, including chairing the Nuclear Data Advisory Group, as delineated in the Nuclear Criticality Safety Program (NCSP) Five-Year Plan dated September 2011, or as directed by the NCSP Manager; and for participation in the Criticality Safety Support Group (CSSG) as it provides technical support to the NCSP Manager regarding planning and execution of the NCSP.

ANL POC: Richard McKnight (630-252-6088), rdmcknight@anl.gov

DOE POC: Jerry McKamy, NNSA (301-903-7980)

**Brookhaven National Laboratory (BNL): \$150K** 

Task: Nuclear Data

Reflects funds to continue supporting nuclear data activities, including shepherding new data evaluations through the Cross Section Evaluation Working Group (CSEWG) process and subsequent publication of these data in the United States Evaluated Nuclear Data File (ENDF) as delineated in the Nuclear Criticality Safety Program (NCSP) Five-Year Plan dated September 2011, or as directed by the NCSP Manager.

BNL POC: Mike Herman (631-344-2802), <u>mwherman@bnl.gov</u>

DOE POC: Jerry McKamy, NNSA (301-903-7980)

Hanford: \$161K

Task: Information Preservation and Dissemination

Reflects funds for obtaining integral cross sections for actinides from reactor operations and special test data; provide verification and validation for Monte Carlo N Particle Computer Code (MCNP) and selected SCALE code calculations to be added to the database for CritView.

Hanford POC: Raymond Puigh (509-376-3766), Raymond.Puigh@rl.gov

### Idaho National Laboratory (INL): \$75K

Tasks: Information Preservation and Dissemination

Reflects funds to transition International Criticality Safety Benchmark Evaluation Project (ICSBEP) to Lawrence Livermore National Laboratory (LLNL) as delineated in the Nuclear Criticality Safety Program (NCSP) Five-Year Plan dated September 2011, or as directed by the NCSP Manager.

INL POC: Blair Briggs (208-526-7628), j.briggs@inl.gov

DOE POC: Jerry McKamy, NNSA (301-903-7980)

Los Alamos National Laboratory (LANL): \$7,545K

Tasks: Analytical Methods, Integral Experiments, Nuclear Data, Training and Education, and the Criticality Safety Support Group

Reflects funds to continue analytical methods; integral experiments; nuclear data; training and education support as delineated in the Nuclear Criticality Safety Program (NCSP) Five-Year Plan dated September 2011, or as directed by the NCSP Manager; and for participation in the Criticality Safety Support Group (CSSG) as it provides technical support to the NCSP Manager regarding planning and execution of the NCSP.

LANL POC: Robert Margevicius (505-606-0109), margevicius@lanl.gov

DOE POC: Jerry McKamy, NNSA (301-903-7980)

Lawrence Livermore National Laboratory (LLNL): \$3,998K

Tasks: Analytical Methods, Information Preservation and Dissemination, Integral Experiments, Nuclear Data, Training and Education, and the Criticality Safety Support Group

Reflects funds to continue support for analytical methods; the U.S. Department of Energy Nuclear Criticality Safety Program (NCSP) website; the accident dosimetry exercise in Valduc, France; nuclear data; and hands-on criticality safety training, as delineated in the NCSP Five-Year Plan dated September 2011, or as directed by the NCSP Manager; and for participation in the Criticality Safety Support Group (CSSG) as it provides technical support to the NCSP Manager regarding planning and execution of the NCSP.

LLNL POC: David Heinrichs (925-424-5679), heinrichs 1@llnl.gov

# Nevada National Security Site (NNSS): \$3000K *Task: Integral Experiments*

Reflects funds to continue support for integral experiments, as delineated in the Nuclear Criticality Safety Program (NCSP) Five-Year Plan dated September 2011, or as directed by the NCSP Manager; and for participation in the Criticality Safety Support Group (CSSG) as it provides technical support to the NCSP Manager regarding planning and execution of the NCSP.

NNSS POC: Joel Leeman (702-295-4899), LeemanJD@nv.doe.gov

DOE POC: Jerry McKamy, NNSA (301-903-7980)

### Oak Ridge National Laboratory (ORNL): \$2,961K

Tasks: Analytical Methods, Information Preservation and Dissemination, Integral Experiments, Nuclear Data, Training and Education, and the Criticality Safety Support Group

Reflects funds to continue support for analytical methods; information preservation and dissemination; integral experiments; nuclear data; the acquisition and evaluation of new differential nuclear data; criticality safety related code distribution and user support through Radiation Safety Information Computational Center (RSICC); and the coordination of the Nuclear Criticality Safety Program (NCSP) Training Program, as delineated in the NCSP Five-Year Plan dated September 2011, or as directed by the NCSP Manager; and for participation in the Criticality Safety Support Group (CSSG) as it provides technical support to the NCSP Manager regarding planning and execution of the NCSP.

ORNL POC: Mike Dunn (865-574-5260), dunnme@ornl.gov

DOE POC: Jerry McKamy, NNSA (301-903-7980)

Renssalaer Polytechnic Institute (RPI): \$314K

Task: Nuclear Data

Reflects funds to conduct differential nuclear data measurements and data evaluations delineated in the Nuclear Criticality Safety Program (NCSP) Five-Year Execution Plan dated September 2011, or as directed by the NCSP Manager.

RPI POC: Yaron Danon (518-276-4008), danony@rpi.edu

# Sandia National Laboratories (SNL): \$890K Tasks: Integral Experiments, Training and Education

Reflects funds to continue support for integral experiments and hands-on training as delineated in the Nuclear Criticality Safety Program (NCSP) Five-Year Execution Plan dated September 2011, or as directed by the NCSP Manager.

SNL POC: Gary Harms (505-845-3244), gaharms@sandia.gov

# Appendix B Nuclear Data

	Priority Needs / Ac			Thermal s Pb, W, <sup>55</sup> N <sup>233</sup> U, Th, E 180,128,183,18	<mark>Scattering</mark> Mn, Ti, <sup>240</sup> l Be, <sup>51</sup> V, Zr, <sup>84,186</sup> W (10	(BeO, HF, Pu, Fe, <sup>58</sup> N F, K, Ca, N	D <sub>2</sub> O, SiO <sub>2</sub> , i, <sup>60</sup> Ni, <sup>63</sup> C Mo, Na, La 09), <sup>52,52</sup> Cr	CH <sub>2</sub> , C <sub>2</sub> F <sub>4</sub> , u, <sup>65</sup> Cu /	C <sub>5</sub> O <sub>2</sub> H <sub>8</sub> , e	tc.), <sup>239</sup> Pu,	Cr, <sup>237</sup> Np,
	Completed Eval	uations (F	<b>Y</b> )	<sup>39,41</sup> K (09	), <sup>19</sup> F (09)	)), <mark>Tu</mark> ((	)), <u>CI</u>	(07),	<b>(</b> 0 <i>)</i> , 1	<b>viii</b> (0 <i>)</i> ,	
	Materials	Pre- FY2011	FY2011	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017	FY2018	Post- FY2011
	Cerium (Ce)										
S	Copper (Cu)										
ent	Dysprosium (Dy)										
em	Gadolinium (Gd)										
Measurements	Strontium (Sr)										
<i>lea</i>	Tungsten (W)										
~	Vanadium (V)										
	Zirconium (Zr)										
	Materials	Pre- FY2011	FY2011	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017	FY2018	Post- FY2011
	Cerium (Ce)										
	Chromium (Cr)										
	Copper (Cu)										
	Dysprosium (Dy)										
	Gadolinium (Gd)										
	Iron (Fe)										
Si	Lead (Pb)										
tion	Manganese (Mn)										
Evaluations	Minor Actinides										
EVa	Nickel (Ni)										
7	Plutonium-239										
omplete	Strontium (Sr)										
Om	Tungsten (W)										
<u> </u>	Uranium-235										
	Uranium-238										
	Vanadium (V)										
	Zirconium (Zr)										
	Polyethylene (CH <sub>2</sub> )										
	Silicon Dioxide(SiO <sub>2</sub> )										
		ORNL		RPI		LANL					

- Requests for additional IE measurements: Ni, Mo, Cr (Fe-Cr alloys), Mn in intermediate energy range (VNIITF, NCERC).
- Request for measurements and evaluation of angular distributions at high energy for Cu.
- Continuing need for thermal scattering data.

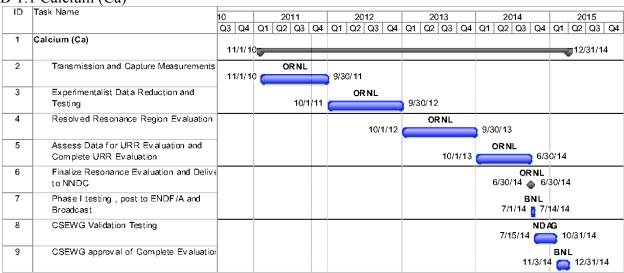
### **B-1 Differential Measurements and Evaluations – Elements**

- B-1.1 Calcium (Ca)
- B-1.2 Carbon (C-12, 13)
- B-1.3 Cerium (Ce)
- B-1.4 Chromium (Cr-50, 52, 53, 54)
- B-1.5 Copper (Cu-63, 65)
- B-1.6 Dysprosium (Dy-161,162,163,164)
- B-1.7 Gadolinium (Gd-155,156,157,158,160)
- B-1.8 Iron (Fe-56)
- B-1.9 Lead (Pb-208)
- B-1.10 Manganese (Mn-55)
- **B-1.11 Minor Actinides**
- B-1.12 Nickel (Ni-58, 60)
- B-1.13 Plutonium (Pu-239)
- B-1.14 Strontium (Sr)
- B-1.15 Tungsten (W-182,183,184,186)
- B-1.16 Uranium (U-235)
- B-1.17 Uranium (U-238)
- B-1.18 Vanadium (V-51)
- B-1.19 Zirconium (Zr-90, 91, 92, 94, 96)

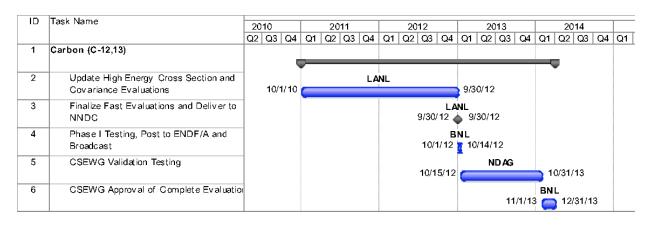
### **B-2 Differential Measurements and Evaluations – Compounds**

- B-2.1 Polyethylene (CH<sub>2</sub>)
- B-2.2 Silicon Dioxide (SiO<sub>2</sub>)

B-1.1 Calcium (Ca)



### B-1.2 Carbon (C-12, 13)



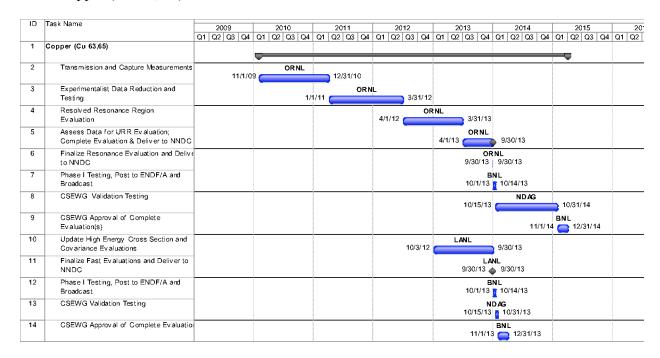
# B-1.3 Cerium (Ce)

ID	Task Name		20	44			2012			2013			201	4	_		201	_			2016	
		01	Q2		Ω4	Q1		04	Ω1	Q2 Q3 (	04	01			)4	Q1			04	Q1 C		
1	Cerium (Ce)	-				_	1 44	1 4.		1 44 1 44 1			**-			-						-
2	Transmission and Capture Measurements			11	/1/1	1	ORNI		9/2	28/12										•		
3	Experimentalist Data Reduction and Testing						10,	/1/12		ORNL		9/30	)/13									
4	Resolved Resonance Region Evaluation									10/1/	13		OR	NL	<b>=</b>	9/30	)/14					
5	Assess Data for URR Evaluation and Complete URR Evaluation													10/1/1	14	C	RNL		6/3	)/15		
6	Finalize Resonance Evaluation and Deliver to NNDC																6/30/	OR I		)/15		
7	Phase I Testing, Post to ENDF/A and Broadcast																7/1/	BN 15		4/15		
8	CSEWG Validation Testing																7/15/		ND A		31/15	
9	CSEWG Approval of Complete Evaluation																	11/	1/15	BNL	12/31	/15

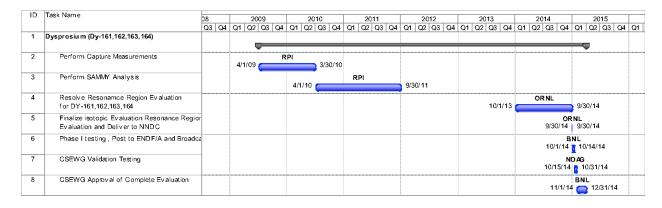
# B-1.4 Chromium (Cr-50, 52, 53, 54)

ID	Task Name	2010	n			20	11			20	012		Т	20	113			20	)14	
		Q2 (		Q4	Q1			Q4	Q1			Q4	Q1			Q4	Q1		Q3	Q4
1	Chromium (Cr50,52,53,54)																			
				_																
2	Review European Evaluation						LA	NL												
	Submitted for END F/B-VII.1 and	'	10/4/	10							3/3	31/12								
	Suggest Any Needed Improvements																			
3	Finalize Fast Evaluation and Deliver t										WL									
	NNDC								3/31/	12 4	3	/31/1	2							
4	Phase I Testing, Post to ENDF/A and										BNL									
	Broadcast								4/:	2/12	4/	13/1:	2							
5	CSEWG Validation Testing										N	D AG								
									4/1	6/12	2		1	0/31/	12					
6	CSEWG Approval of Complete												BN	L						
	Evaluation(s)										11	1/1/1:	2 🧰	12	/31/1	2				

# B-1.5 Copper (Cu-63, 65)



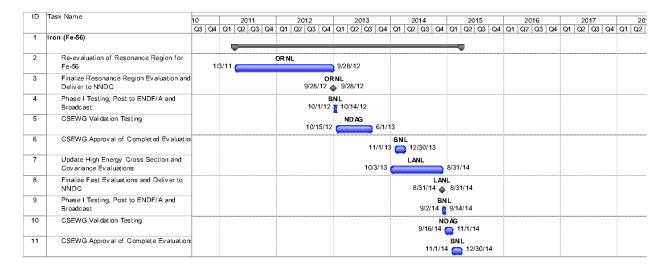
# B-1.6 Dysprosium (Dy-161,162,163,164)



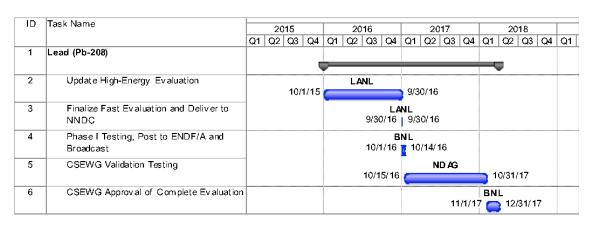
# B-1.7 Gadolinium (Gd-155,156,157,158,160)

ID	Task Name	2007	20	108		1009	_	201	n		201	1		2012			201	ì.		20	1/1	$\overline{}$	=
			Q1 Q2				1 Q1			Q1			Q1 (		Q4	Q1			4 Q1			Q4 (	<b>⊋1</b>
1	Gadolinium (Gd-155,156,157,158,160)																						
		<u> </u>	 '																	Ψ			
2	Perform Capture Measurements					RPI			0100110														
			4/1/08						3/30/10														
3	Perform SAMMY Analysis									RF	Pl												
							4/1	1/10 🍯					9/30.	11									
4	Resolve Resonamce Region Evaluation									(							ORN	L					
	for Gd-155, 156, 157, 158, 160													10	1/12				9/	30/13			
5	Finalize Resonance Region Evaluation and																		RNL				
	Deliver to NNDC																9/	30/13	9	/30/13	i		
6	Phase I Testing, Post to ENDF/A and				1														BNL				
	Broadcast																1	0/2/1	3 📜 1	0/12/1	3		
7	CSEWG Validation Testing	1																	NDA	•			
																	1	)/13/1	3	11/1/1	3		
8	CSEWG Approval of Complete Evaluations		 																В١	IL.			
																		11/1/	13 👛	12/	31/13		

### B-1.8 Iron (Fe-56)



### B-1.9 Lead (Pb-208)



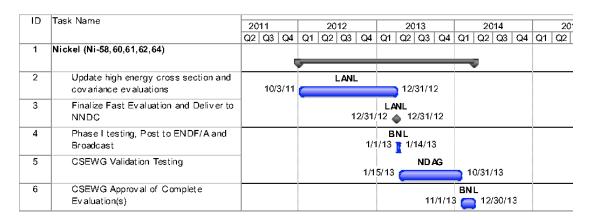
# B-1.10 Manganese (Mn-55)

ID	Task Name																
10	Task Ivallic	þ9			20	10			20	11			201	12			201
		Q3	Q4	Q1	Q2	QS	3 Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
1	Manganese (Mn-55)																
					- 4	;						=					
2	Review European Submittal for ENDF/B-VII.1 and							LA	NL								
	Suggest Any Improvements Needed			4/1	/10							9/3	0/11				
3	Finalize Fast Evaluation and Deliver to NNDC									9/30/		NL 9/	30/11	I			
4	Phase I Testing, Post to ENDF/A and Broadcast									10/3		NL 10	/14/1	1			
5	CSEWG Validation Testing									10/1		DAG	0/31/	11			
6	CSEWG Approval of Complete Evaluations									11	/1/1°	BN 1		30/1	1		

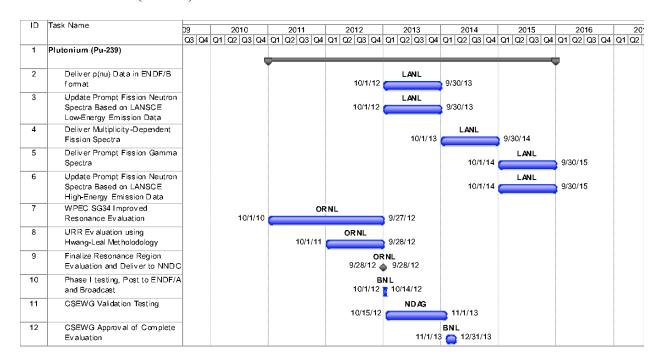
# B-1.11 Minor Actinides

ID	Task Name	_												_				_			
	Took Home		20	10			20	111				2012				2013			20	14	
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	2   Q:	3 Q4	I Q1	l Q	2 Q3	3 Q4	Q1	Q2	Q3	Q4
1	Minor Actinides																				
									-					+	$\overline{}$						
2	Improve Prompt Fission Neutron Spectro										L	ANL									
	for all Minor Actinides Using Systematic							10/1	/11					<b>=</b> 9/	30/1	12					
	and Deliver Updated Evaluations													7							
3	Phase I Testing, Post to ENDF/A and												L	ÀNL							
	Broadcast											10	0/1/12	2 🦙 1	0/14	1/12					
	CCCMC Maliabetian Traction	<u> </u>												*				-			
4	CSEWG Validation Testing													BNL		4440					
												10	/15/1	2 [	10/3	1/12					
5	CSEWG Approval of Complete Evaluation													ND	AG						
													11/1/1	12 📶	<u> </u>	2/31/	12				
														- 1 💆	-						

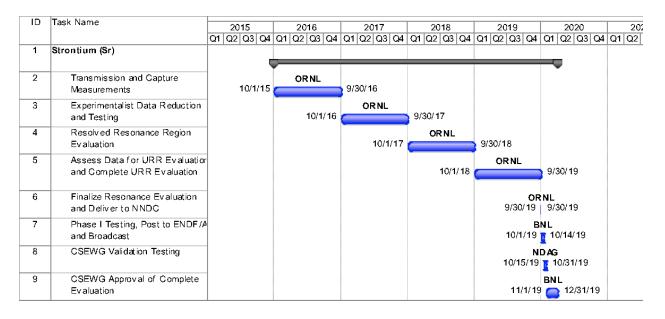
# B-1.12 Nickel (Ni-58,60)



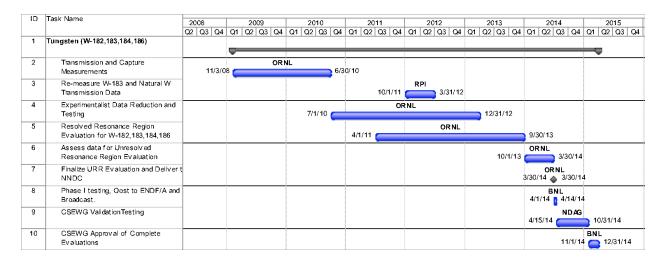
### B-1.13 Plutonium (Pu-239)



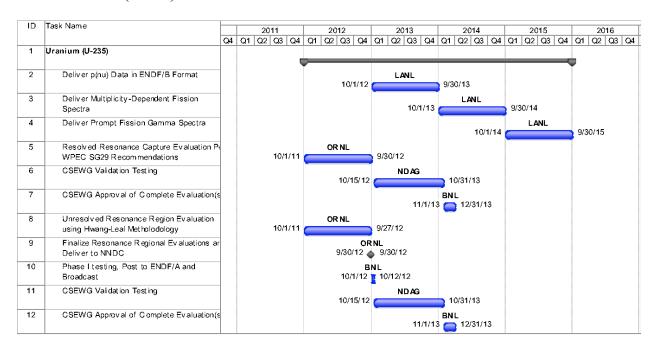
### B-1.14 Strontium (Sr)



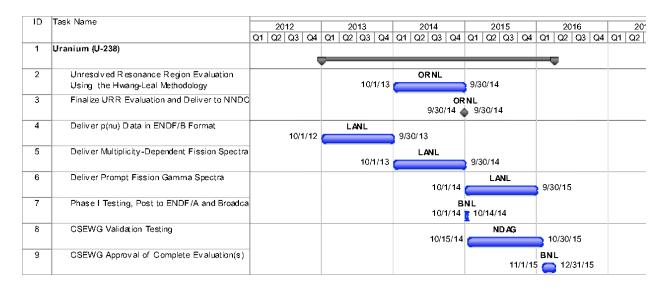
### B-1.15 Tungsten (W-182,183,184,186)



### B-1.16 Uranium (U-235)



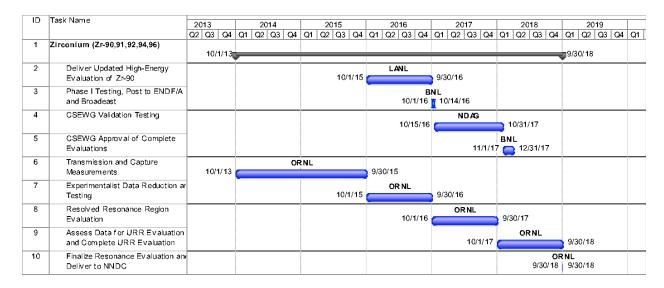
# B-1.17 Uranium (U-238)



B-1.18 Vanadium (V-51)

ID	Task Name	2012		2013		2014			2015			201	16	Т		2017		Т	201	8	Т	20
		Q1 Q2 Q3 Q4	Q1 (		Q4 Q		Q4	Q1		Q4	Q1 (			24 (	21		3 Q4	Q1		Q3 Q4	Q1	
1	Vanadium (V-51)	11/1/12	2																12/3	1/17		
2	Complete Resonance Region Measurements	11/1/12	2	ORNL	9	/30/13																
3	Experimentalist Data Reduction ar Testing			10/1/	13 🧲			9/30	/14													
4	Resolved Resonance Region Evaluation					10/	1/14				9/30	/15										
5	Assess data for Unresolv ed Resonance Region Evaluation								10/	1/15		OR	NL	=	9/30	/16						
6	Finalize Resonance Evaluation and Deliver to NNDC											ç	9/30/1	ORN 6 秦		0/16						
7	Phase I Testing, Post to ENDF/A and Broadcast												10/1/	BN 16		14/16						
8	CSEWG Validation Testing												10/15/	16 (		NDA	G	5	10/31/1	17		
9	CSEWG Approval of Complete Evaluation(s)																11/1/1		NL 12/3	1/17		

# B-1.19 Zirconium (Zr-90,91,92,94,96)



B-2.1 Polyethylene (CH<sub>2</sub>)

	<u> </u>							
ID	Task Name	2011	2012	2013	2014	2015	2016	20
		Q1 Q2 Q3 Q4	Q1 Q2					
1	Polyethylene (CH2)							
						~		
2	Thermal Scattering Evaluation with NCS			ORNL				
			10/1/12		9/30/13			
3	Finalize and Deliver Evaluation to NNDC			OF	NL			
				9/30/13	9/30/13			
4	Phase 1 Testing, Post to ENDF/A and			В	NL			
	Broadcast			10/1/13	10/14/13			
5	CSEWG Validation Testing				NDAG			
				10/15/13		10/31/14		
6	CSEWG Approval of Complete Evaluation					BNL		
					11/1/14	12/31/14		

# B-2.2 Silicon Dioxide (SiO<sub>2</sub>)

ID	Task Name																	_				_	
		20				20				_	2010	•	$\rightarrow$			11		_	_	012		-	20
		Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q	2   0	23   (	Q4	Q1	Q2	Q3	Q4	Q1	Q2	2   Q3	Q4	Q1	Q2
1	Silicon Dioxide (SiO2)																						
							11/	1/09	9									Ħ	<b>3</b> 12	2/30/	11		
2	Assess Thermal Scattering (CNEA/ORNL										-	ORN	IL										
	Assessment of NCSP Thermal								3/1/	10		-		9/30	0/10								
	Moderators)												_										
3	Thermal Scatterin Evaluation										ORI	NII.											
Ü	The man Goatterm Evaluation						11/	1/09	! a 🚐		ŲK I	NL.	_	0/2	9/10								
							1 17	1,0.						JIZ.	Jr 10								
4	Finalize Thermal Scattering Evaluation;												-	NL									
	Deliver to NNDC										10	)/3/1	10 👍	10	/3/1	0							
5	Phase I Testing. Post to ENDF/A and												B	NL									
-	Broadcast										1	0/4/		10	/17/	10							
		<u> </u>										<b>4</b> 1 .1										_	
6	CSEWG Validation Testing														N	ID AG							
											1	0/18	3/10					<b>1</b>	10/3	1/11			
7	CSEWG Approval of Complete Evaluation																	BN	II.				
-																11	/1/1			2/30/	11		

Appendix C Fiscal Year 2012 Projected Foreign Travel

Destination	Date	Labs	Count	Costs (\$)	One Sentence Justification
Destination	Date	Laus	Count	Costs (\$)	ENDF representative to WPEC
NEA WPEC France	5/2012	ANL, RPI, ORNL, LANL	5	22,000	meeting, HPRL and data adjustment expert groups (McKnight, Danon, Leal, Dunn and Kahler)
Paris, France	9/2012	ANL, ORNL, LANL	3	14,000	U.S. representative on WPNCS and participate in associated expert groups (McKnight, Parks and Brown)
Paris, France	9/2012	ORNL- AM2	1	5,000	Expert group on uncertainty analyses for criticality safety (Rearden)
WGB9, Germany	TBD	LLNL-IE	2	14,000	WGB9 meeting on IEC 60860 Ed.2: radiation protection instrumentation (Heinrichs and Dulik)
AWE and IRSN	TBD	LLNL-IE	2	20,000	Attend meetings at AWE/Aldermaston and IRSN/Paris concerning their participation in LLNL (Heinrichs and Scorby)
Nara, Japan	09/2012	LLNL-IE	1	7,000	ICRS/RPSD-2012 (Heinrichs)
IRMM Mol, Belgium	11/2011 6/2012 9/2012	ORNL-ND1	1	50,000	Perform resonance region nuclear data measurements using the GELINA facility at IRMM (Guber)
CEA, France	11/2011	ORNL-ND1	1	8,000	Complete new <sup>239</sup> Pu resonance region evaluation (Leal)
IRMM Mol, Belgium	3/2012	ORNL-ND1	1	5,000	Complete new <sup>56</sup> Fe resonance evaluation (Leal)
TOTAL				145,000	

# Appendix D NCSP FY2012 PLANNING CALENDAR

September 16, 2011	Final Comments on Five-Year Plan due To NCSP Manager
October 1, 2011	NCSP Manager Publishes Five-Year Execution Plan for FY12-16
October 28, 2011	4th Quarter FY11 Quarterly Progress Reports due to NCSP Manager
November 1, 2011	NCSP Staff meeting with NCSP Manager
November 2, 2011	Winter ANS Session: Recent Nuclear Criticality Safety Program Technical Accomplishments
November 18, 2011	FY 2011 Close-Out Quarterly Program Review (QPR) Teleconference
December 30, 2011	FY 2011 Accomplishments Posted on the NCSP Website
January 6, 2012	Request for Proposals for FY 2013-2017 to Task Managers
January 27, 2012	Formal Written Proposals for FY 2013-2017 Tasks and Submittal of all new Intergral Experiment Requests (IER) for consideration during FY13 review due to NCSP Manager
January 31, 2012	1st Quarter FY 2012 Quarterly Progress Reports due to NCSP Manager
February 3, 2012	FY 2012 1st Quarter QPR Teleconference
February 17, 2012	Proposals Forwarded to CSSG, NDAG and Task Managers along with Preliminary Prioritization Supporting NCSP Vision
February 17, 2012	NCSP Manager Reviews and acts on all newly submitted IERs since publication of the FY12 Five Year Plan; and include a listing of all newly Approved CED-0s for Gantt charts
February 28-29, 2012	NCSP Technical Symposium at ORNL

March 1-2, 2012	Joint Meeting of CSSG, NDAG, and Task Managers with NCSP Manager at ORNL to Discuss Proposals. Proposals for newly approved CED-0 IERs present and also for IERs with CED-2 or 3 milestones due in FY13
March 31, 2012	2nd Quarter FY 2012 Quarterly Progress Reports due to NCSP Manager; CSSG final Prioritization of tasks due to NCSP Manager
May 10, 2012	NCSP Technical Symposium Award Winners Notified
May 11, 2012	NCSP Manager Publishes Final Task List for FY 2013-2017
May 24, 2012	FY 2012 2nd Quarter QPR Teleconference
June 8, 2012	Task Managers Provide Updated Sections of the Five Year Plan with Final Approved Tasks and Milestones to NCSP Manager
June 19, 2012	NCSP staff meeting with NCSP Manager to Review Five Year Plan and finalize site splits
June 29, 2012	NCSP Award Attendees to Winter ANS Meeting Submit Abstracts
July 13, 2012	NCSP Manager Publishes First Draft of Five Year Plan
July 31, 2012	3rd Quarter FY 2012 Quarterly Progress Reports due to NCSP Manager
August 6-10, 2012	Joint Meeting of Task Managers with NCSP Manager in Las Vegas to Finalize FY13 Budget Execution Plan. FY12 3 <sup>rd</sup> Quarter QPR discussion
August 24, 2012	Final Comments on the Five Year Plan Due to NCSP Manager
October 1, 2012	Approved Five Year Execution Plan for FY 2013-2017 Issued
November 13, 2012	NCSP Staff meeting with NCSP Manager